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A Literature Study on the Definitions, Methodologies, and Promoting Factors of eLearning Effectiveness

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Understanding and Utilizing the Effectiveness of e-Learning: A Literature Study on the Definitions, Methodologies, and Promoting Factors of e-Learning Effectiveness

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Abstract: A structured search of librarian databases revealed that the research into the effectiveness of e-Learning has heavily increased within the last 5 years. Taking a closer look at the search results, the authors discovered that researchers define and investigate effectiveness in multiple ways. At the same time, learning and development professionals within public and private organizations are increasingly met with a demand to prove the effectiveness of their learning and development initiatives. This paper investigates the concepts of effectiveness in e-Learning. It broadens the definition of effectiveness and qualifies certain measurements of same. Preliminary results from a literature study and an empirical investigation of 'the effectiveness of e-Learning' for science teachers (K12) are combined. The paper discusses the following research questions: How is the effectiveness of e-Learning defined? How is the effectiveness of e-Learning measured? What makes e-Learning solutions effective? The literature study entailed a structured search of literature, which left the authors with 761 relevant abstracts from journal articles. The sorting criteria were that the articles' topics were on the effectiveness of e-Learning within adult learning contexts, and that the articles were based on an empirical study. The selected abstracts are currently being coded and analyzed in detail. Although this literature study is still a work in progress, the authors have already discovered 19 distinct ways to define effectiveness. The findings indicate that effectiveness is defined as 'learning outcome' in 41 % of the articles. Moreover, the most common way to measure the effectiveness is clearly through quantitative methods and a pretest/posttest-setup is most commonly used. An empirical study of an e-Learning solution for science teachers (K12) brings valuable elements into the discussion of the findings of the literature study. The empirical study suggests that it is difficult to turn e-Learning into improved teaching performance, as the participating teachers for instance apply several strategies to avoid substantial changes to their work practice. Furthermore, the study shows that solely measuring on the fulfilment of pre-defined learning objectives as effectiveness parameters, disallows developers and researchers to see unexpected and unintended transfer to practice based on the e-Learning program. Finally, the research brings valuable input to the discussion of the validity of self-assessments suggesting that participants are able to report on their own practices provided certain qualitative survey approaches. Understanding the many ways to define effectiveness can help learning and development professionals reflect on their practices and thus better target their measuring efforts to counting what counts for them and their stakeholders.

Keywords: effectiveness, e-Learning, adult learning, literature study, definition, measurement

1. Introduction

The research into the effectiveness of e-Learning has increased heavily within recent years. This is due to primarily the growth in technological possibilities for IT and learning, as well as an increased political and organizational attention to "what works" in learning. Figure 1a, reflects the total of 761 papers in our search, and Figure 1b reflects 111 intensively coded abstracts (details in the methodology section below). The number of papers decreases in the year 2013, because the structured search took place beginning October 2013. Consequently, not all papers published in 2013 are included.

In the following analysis, the authors investigate the effectiveness definitions and measures applied by researchers. This paper is structured around the three research questions: How is the effectiveness of e-Learning defined? How is the effectiveness of e-Learning measured? What makes e-Learning solutions effective? Hence, the aim of this literature study is to create a structure of the research within the field to understand the characteristics, tendencies, and connections between the applied concepts.

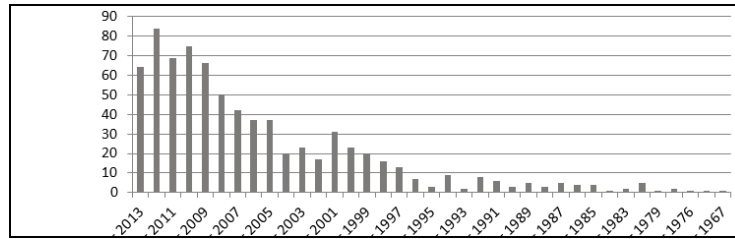


Figure 1a: Number of published papers per year

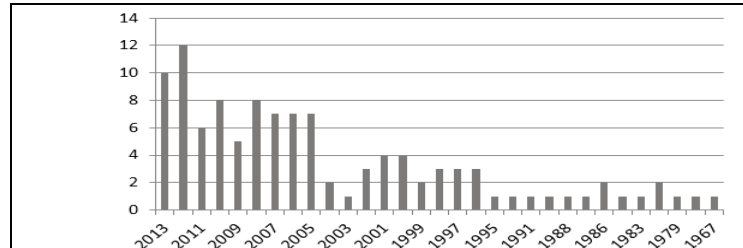


Figure 1b: Number of published papers with abstracts coded per year

1.1 The literature study - methodology

When searching for systematic reviews and meta-studies on the effectiveness of e-Learning several are found within health care and language learning. These reviews do, however, primarily include quantitative studies based on certain criteria, such as sample size (Veneri, 2011), transparency in statistical numbers provided (Grgurovic, Chapelle, & Shelley, 2013; Means, Toyama, Murphy, & Baki, 2013), or homogeneity of respondent and predefined outcome measures (Rosenberg, Grad, & Matear, 2003). Only one meta-review related to the literature study of this paper was found. This included both qualitative and quantitative studies in an integrative review evaluating student outcome of distance learning in the nursing education literature (Patterson, Krouse, & Roy, 2012).

The quantitative meta-reviews found aim to document the effectiveness of e-Learning, i.e. consolidating the data of a number of quantitative studies to understand *if* e-Learning is effective. The mixed method meta-review mentioned above, describes the state of the research, explains how the studies evaluate different types of outcomes, and discusses different aspects of learning effectiveness. This is somewhat similar to the intention of the present paper, which also applies a mixed method methodology. However, in here a much larger amount of research articles is brought into play due to broader selection criteria. Hence, this paper is not concerned with re-investigating *how* effective e-Learning is, but with understanding definitions, measurements, and promoting factors of e-Learning effectiveness.

The authors conducted conventional subject searches in 30 academic databases (In J-stor, Scopus and Proquest (28 databases)) on the effectiveness of e-Learning in adult contexts as per below (Table 1). All fields of research were included in the searches as e-Learning can be created to support any subject and may thus appear within any of these. The searches only included articles in English and where possible only peer-reviewed journals were included. Please note that the chosen synonyms for 'effectiveness' include 'transfer' and 'application'. This may have placed extra emphasis on finding articles defining effectiveness as such.

The searches initially revealed close to 1000 articles. A rough sorting of articles, which excluded articles clearly irrelevant to the subject brought down the number to 761. If the paper contained an empirical study on the effectiveness of e-Learning, and the e-Learning solution under investigation was targeted at working professionals or students within professional or higher education, then the abstracts were carefully coded and analyzed in great detail (using Nvivo 10). When doubts about relevance or coding of the abstracts surfaced, the two authors discussed the specific abstract, decided on the best coding, and documented the learning from the discussion in a shared document.

Table 1: Applied search string

effect* OR transfer* OR applica* OR impact OR outcome*(search title)
AND
“e-Learning” OR e-Learning OR online OR web-based OR “web based” OR technolog* OR WBT OR WBL OR blended OR Internet OR Distance OR CBT OR CBL OR distance OR Computer OR mobile OR simulation* OR “social media” OR “community of practice” OR game* OR gamification* (search title)
AND
learning OR training OR education OR development OR “competence development” (search title)
AND
adult OR “competence development” OR lifelong OR profession* OR employe* OR worker* OR “further education” OR master OR business* (search abstract)
NOT Children OR Child OR kids OR Youth OR “Technology transfer”(search anywhere)

Before the coding began, a rough coding scheme was created based on the research questions, which entailed parent codes (named ‘nodes’ in NVivo) like ‘definition of effectiveness’, ‘research question’, ‘research methodology’, ‘subject area’, ‘audience’, ‘theories applied’, ‘technology applied’, ‘key findings’ etc. The detailed coding tree was, however, created through in-Vivo-coding, a grounded approach, where codes are added as the analyses reveals relevant factors and by applying the original statement of the source as code name (Harry, Sturges and Kingner 2005). In addition, new sub-nodes are continuously being created as new definitions, new findings of effectiveness factors, new technologies etc. appear in the abstracts.

Currently 224 abstracts have been carefully read, and 111 of these papers lived up to above criteria and have been coded in detail using the above mentioned method. These abstracts have been chosen randomly, and not alphabetically to avoid cultural influence due to local spelling of surnames. The below results are based on the coding of the 111 abstracts.

1.2 The empirical study – bringing context into the literature study

The research question of the empirical study is if, how, and why an e-Learning program for science teachers in the Danish elementary schools (K12) works in practice. Thus, the empirical study lives up to the criteria of the literature study as it focuses on the effectiveness of e-Learning for working professionals. This empirical study is brought to play as it exemplifies some of the challenges highlighted by the literature study.

The solution and the learning design is a competence development initiative on the natural science teaching methods. In this project, effectiveness is understood as the transfer of learning, which positively impacts teaching practices. The e-Learning solution was investigated intensively from February to June 2014 with 7 teachers at three Danish elementary schools.

The data gathering method entailed extensive in-class video-recordings and observations. The researcher recorded the teaching and used a mobile ethnographic approach, i.e. the teachers had a small camcorder attached to their neck, which enabled the researcher to view the teaching from the teachers’ perspective. This data consists of approx. 120 hours of in-class video recordings and 100 pages of observation notes. Secondly, the researcher had reflection-sessions at the three schools with 2-3 teachers at a time before and after the e-Learning. These sessions were inspired by the mind tape/retrospective interview methodologies (as in Kumar, Yammiyavar, Nielsen 2007). Thirdly, the teachers’ interaction with the e-Learning including their preparation for classes was recorded through Camtasia; a software that allows for both recoding the screen, mouse movements, and a picture-in-picture setting of the user. Here the think-aloud approach was applied (Nielsen, Clemmensen & Yssing 2002). This data consist of approx. 25 hours of video recordings and 40 pages of observation of teacher interaction with the e-Learning. Finally, the teachers responded to a satisfaction survey immediately following the conclusion of the e-Learning as well as a pre-survey shortly before initiating the e-Learning and a post-survey approx. one month after completion of the e-Learning. The latter will be repeated 6 months after completion. This final data consist of 28 responses to the surveys of approx. 20 questions each.

The approach to gathering empirical data was specifically designed to capture some of the complexity, possibilities, challenges, and actual realizations of impact on teaching practices – expected *and* unexpected. In the following the preliminary results of the empirical study is included when they provide valuable input to the research questions of this paper.

2. How is the effectiveness of e-learning defined?

In the literature study approx. one third of the abstracts are currently coded; still, as many as 19 different ways to define effectiveness has been located. These are listed below in chronological order with the definition most used at the top. Table 2 refers to 92 papers of the 111 currently coded. The remaining abstracts did not state the target audience and are therefore not included in this table.

The individual numbers under the 19 definitions amount to 170 and not 92 papers. This is because a set of definitions is often used to investigate the effectiveness of an e-Learning solution, for example several papers use both 'learning outcome' and 'satisfaction' as part of their effectiveness definition (fx. Harrington & Walker, 2009; Jung, Choi, Lim, & Leem, 2002; Maloney et al., 2011). The numbers of this list is continuously changing as the study proceeds, though the clearest tendencies is expected to stay relatively stable, as these have not changed significantly in the latest abstracts reviewed.

Table 2: Definitions of effectiveness divided by adult learning context

	Higher education	Work related learning	Total
Number of papers:	52	40	92
Distribution of papers:			
Learning outcome	29	9	38
Transfer (application to practice)	3	15	18
Perceived learning, skills, or competency	11	6	17
Attitude	8	3	11
Satisfaction	8	3	11
Skills acquired	5	5	10
Usage of product	4	5	9
Learning retention	4	4	9
Completion	0	5	5
Motivation and engagement	3	2	5
Organizational results	0	5	5
Application to simulated work practice	0	4	4
Self-efficacy	0	4	4
Confidence	1	2	3
Cost-effectiveness	1	2	3
Connectedness	1	1	2
Few errors	2	0	2
Raised Awareness	0	2	2
Success of (former) participants	1	0	1
Undefined effectiveness	10	2	12

57 % (52/92) of the papers are within higher education. Within this field, the most prominent definition of e-Learning effectiveness is clearly 'learning outcome' with 56% (29/52) of these papers applying this definition. Within work related learning the most used definition is 'Transfer (application to practice)' with 38% (15/40) of the papers within the field applying this definition.

'Learning outcome' refers to participants showing signs of new understanding stemming from the e-Learning initiative. 'Learning outcome' is of course a broad definition, but often in the abstracts of higher education, the definition is clarified in terms of measurements, for example: *"Student learning measurements included: pre-test, final examination (post-test), and final letter grade."* (Boghikian-Whitby, & Mortagy 2008).

Within the field of work-related learning, the actual application of learning or performance of employees is essential. For example in a study on teachers' technology competencies, it was not 'knowing about', but the actual *"integration of computer activities with appropriate inquiry-based pedagogy in the science classroom"* that constituted effectiveness (Angeli 2005).

It is, however, interesting that 'Transfer (application in practice)' is sometimes evaluated through the participants' self-assessments: *"Outcomes were measured across levels 1 to 3 of Kirkpatrick's hierarchy of educational outcomes, including attendance, adherence, satisfaction, knowledge, and self-reported change in*

practice” (Maloney et al 2011) and “A follow-up questionnaire showed that two-thirds of those who viewed the program had subsequently reviewed the performance data for the initial wire they were using and 20% had changed it.” (Marsh et al 2001). This brings into light the discussion of whether or not it is possible for learners to assess own transfer, i.e. if people say what they do, or if researchers, managers, peers, or learning professionals also have to observe what is actually done.

On the other hand, since much attention in the learning literature is given to engagement and motivation as necessary factors for knowledge gain and learning transfer, it is surprising that only 5 papers include these aspects in their research (Table 2).

Some papers investigate the interrelatedness of more aspects of effectiveness, such as the relation between learning outcome/retention and behavior. As an example, Hagen et al. (2011) found that “...the effects of the intervention on security awareness and behavior partly remains more than half a year after the intervention, but that the detailed knowledge on information security issues diminished during the period.” Such a study challenges the idea that behavior change can be measured through learning retention.

Table 2 also shows that the abstracts within higher education operate with few definitions besides ‘learning outcome’ while the papers within work related learning to a larger extent apply the great variety of definitions. This could be because universities work with performance requirements that primarily revolve around examination grades and completion rates, leading to measures of effectiveness as cognitive knowledge indicators. In a work-related setting, effective learning entails a broader repertoire, including aspects that are not bound to the individual or a project group such as application to work context, organizational results, cost-effectiveness etc.

In addition, it became clear in our analyses, that many abstracts and some papers do not state how they define effectiveness. 13 % (12/92) of the abstracts leave effectiveness completely undefined.

2.1 Why is this important?

The many ways to understand the effectiveness of e-Learning has benefits: it means that professionals and researchers have substantial flexibility in their work to define, measure, and claim effectiveness of e-Learning solutions. The broadness of the concept does, however, also bring challenges. Effectiveness bears different meaning to different people - still effectiveness is often left undefined even by researchers. This may lead to misunderstandings, and the definitions of effectiveness bringing most value to participants and stakeholders may not be applied. Hence, illuminating the many ways to define effectiveness can spark reflection and inspiration on utilizing the concept of effectiveness most appropriately for one’s purpose. Thus, it enables learning professionals to better align expectations and target their measuring efforts to counting what counts for them and their stakeholders.

3. How is the effectiveness of e-learning measured?

The above section broadens the understanding of the definitions applied within research into the effectiveness of e-Learning. But how are these definitions then investigated in the various studies? How do the researchers measure effectiveness and which consequences does this have? Of the 111 abstracts coded in detail, 63 abstracts identify their research design.

Table 3: Research study methods

	Mixed	Qualitative	Quantitative
All abstracts coded with...	9	5	37
Comparative studies applying...	0	1	18

In table 3 the first row depicts the distribution of research studies coded as mixed, qualitative and quantitative studies. In addition, 30 comparative studies were found. 11 of these do not describe in the abstract if they are conducting qualitative, quantitative, or mixed methods research. The rest allocate their research as shown in the second row. Consequently, nearly 73 % (37/51) of these studies are quantitative. Almost half of these are comparative studies, which compare e-Learning with traditional face-to-face and/or blended learning. The vast amount of comparative quantitative studies may be due to the steady interest of policy makers in this research (Grgurovic et al., 2013).

The literature study reveals that the most common way to measure effectiveness is through a quantitative pretest/posttest-setup. To come to an understanding of which effectiveness definitions are most used in which kind of studies, the effectiveness code was correlated with the research methods applied. Such a correlation shows that 'learning outcome' is used more frequently in the quantitative studies (18 papers) than those who are qualitative (2 papers) and mixed studies (1 paper). Of course there are in total more quantitative studies identified than there are qualitative, but the quantitative studies use of 'learning outcome' is significantly higher than this factor.

This literature study reveals that the quantitative studies apply a broader number of the 19 effectiveness definitions. Qualitative studies could be assumed to have a rich repertoire of effectiveness definitions, but this is not the case. Instead, the qualitative studies tend to use only one and sometimes two of the 19 definitions. This could be because qualitative and mixed methods studies aim to go into depth with a single concept and the intentions are often to understand the why's of such a concept. This requires a lot of time and resources to investigate, meaning one or two concepts may be chosen for the effectiveness definitions, whereas quantitative research definitions are chosen as set of variables constituting effectiveness.

The reason for the distribution of research methods in this literature study could be due to both a publication and policy bias. Writing rich descriptions of the 'why's' in qualitative research does require more space than reporting on means and standard deviations. Very few journals allow for such prolonged papers. Not only do the journal policies require authors to adhere to a maximum word-count, but quantitative papers also tend to be in higher demand, in reference to what Grgurovic (2013) names a 'publication bias', i.e. the tendency to publish only studies with statistically significant findings.

3.1 Why is this important?

As stated, most research into the effectiveness of e-Learning focuses on measuring *if* and/or *which* e-Learning solutions are effective using quantitative measures. In the empirical study of the e-Learning program for science teachers the goal was to understand the complex structures when attempting to change teaching practice by use of e-Learning. The solution has an on-the-job learning approach, including in-class practice, and a facilitated team-based competence development setup. Still the empirical study shows that great effort is needed to turn e-Learning into improved teaching performance.

The qualitative analysis of the teachers' interaction with the e-Learning (Camtasia recordings) shows three prevailing strategies, which the teachers use to avoid substantial changes to their work practice:

- 'Find statements to reject content' means that the teachers seemed to be searching for single elements in the e-Learning solution, which they could use to prove it was unrealistic to teach in the suggested ways, considering their specific work context. Some even stated that they preferred the ways of the e-Learning solution, but their context would not allow for it.
- 'Modify content to make change less demanding' refers to the teachers consciously or unconsciously modifying the content so it either became the same as their current practice allowing to state that they are already teaching this way or changing the content so it became easily applicable. Bransford and Schwartz (1999) made the related discovery that people often change the transfer situation until it becomes similar to something they know (Lobato, 2006).
- 'Pinpoint content easily implemented', which meant that the teachers found the elements of the content, which they could easily apply to their teaching without changing it fundamentally.

In the quantitative and qualitative surveys, the teachers were asked to evaluate their application of the program's learning content in the very lessons in which the class-room observations took place. This enabled the researcher to compare the self-assessments of transfer and transfer related concepts (motivation, knowledge, and self-efficacy) with the observation material. This led to the conclusion that all teachers following the program have made noticeable changes in their teaching practice, however, largely by using the third strategy mentioned above.

This research design (see 1.3) also enabled the researcher to capture unintended and unexpected transfer. As an example, one teacher became so fond of her new way of posing questions to the pupils that she now uses the method when she teaches history as well. On the other hand, her co-worker became insecure to an extent

which negatively affected her teaching. Research into learning transfer shows that the classical notion of one-to-one transfer from learning to practice must be challenged (see Lobato, 2006). A challenge when evaluating effectiveness is that unexpected transfer, which can have both positive and negative impact on performance, may not be analyzed, if only known and a priori concepts are investigated. Thus, if only quantitative survey data was gathered, a partly misleading picture of the transfer of learning would have been drawn in the empirical study.

In addition, the teachers generally overestimated themselves in both pre and post-test. However, by including the qualitative elements of the survey (e.g. teachers describe what they did in the lessons with their own words), most discrepancies between self-assessment and observation were clarified and responses could be accepted or corrected accordingly.

A concern is thus the amount of pure quantitative research in the literature study. Results solely relying on rating scales and multiple choice tests can easily become misleading. Openness to participants' own unframed understanding even if solely part of a survey format, can potentially give more valid and usable answers on the effectiveness of e-Learning whether it is defined as learning transfer, learning outcome, satisfaction, or any other definition calling for surveys.

4. What makes e-learning solutions effective?

As part of the coding process, all abstracts were provided with codes on whether the e-Learning was effective, not effective, or partly effective, provided this was stated or indicated in the abstracts, which was the case for 61 of the 111 abstract. Table 4 shows the distribution.

Table 4: Is e-Learning effective or not?

Effective	41
Not effective	6
Partly effective	14

Knowing the challenges of e-Learning, the fact that only 10% (6/61) of the studies are classified as 'Not effective' brought the validity of the classifications into question. Taking a closer look at the abstracts it became clear that a large amount of the empirical effectiveness studies were conducted by researchers which appeared to have a stake in the success of the e-Learning solution. This issue of 'effectiveness bias' means that the literature study at this point does not support the investigation into which e-Learning solutions are particularly effective. Perhaps future analysis of the papers in question can unfold this question. What the study can explore is instead the factors that influence e-learning effectiveness.

A qualitative view on the factors, which the researchers state as promoting or prohibiting e-Learning effectiveness across the spectra of definitions, methodologies, and e-Learning media, provides valuable input to e-Learning design and research. Through in-Vivo-coding, 34 factors were found. Subsequently, a condensation took place in which the 34 factors were divided into the three categories: Individual (subject), Contextual scaffolding (context + object), and e-Learning solution and process (artifact). These categories are inspired by the concepts of activity theory, as they relate to learning and transfer of learning (such as in the thinking of Engeström, Leont'ev, Vygotsky and Orlikowsky). The categorization of the factors is a simplification of these theories, which nevertheless show an interesting distribution of the factors (Table 5). The papers of the literature study clearly prioritize the e-Learning solution and process over contextual factors yet increasing attention is paid to the importance of the context in which the learners work (Noesgaard, 2014). The reason for this phenomenon may be that the contextual factors are perceived as too complex and changeable to investigate and control for research, and that these lay outside the responsibility of learning professionals.

Table 5: Factors that influence effectiveness

Individual (subject)	Context scaffolding (context + object)	E-Learning solution and process (artifact)
Age Entrance scores Experience in profession Language (second language) Learner characteristics Learner preferences	Learning environment Support Technological resources available to user Time available to learn	Active learning Applicable to practice Balance between asynchronous and synchronous activities Cognitive load Collaboration

Individual (subject)	Context scaffolding (context + object)	E-Learning solution and process (artifact)
Locus of control Motivation Perception of learning Previous e-Learning experience Previous training Prior online experience		Communication Computer playfulness Design Expected workload Instructional scaffolding Interaction (learner – instructor and peer2peer) Learner control Modeling Problem-based learning Practice (incl. case study, case-based learning, and simulation) Structure Technological constraints Usability

When it comes to general learner characteristics, the papers agree that effectiveness varies according to individual differences (fx Armatas et al., 2003; Aydoğdu Karaaslan, 2013). Some papers refer broadly to learner characteristics; others discuss particular issues of relevance to their study. Two mentioned characteristics are ‘age’ and ‘previous online experience’ (Table 5). Boghikian-Whitby & Mortagy (2008) suggest “...that adult students benefit more from taking online classes compared to traditional age students, and that computer competency helped improve performance in online classes over time.” (Boghikian-Whitby & Mortagy, 2008). It is also interesting when factors are not mentioned to have an impact on effectiveness such as ‘gender’: “However, although gender is a significant predictor in traditional classroom courses, its effect disappears in Web-based courses. There is evidence that Web-based courses can be conducive to the leaning process of technical knowledge for female students.” (Lam, 2009).

With regards to the e-Learning solution and process, the factors listed in the table are well-known in most academic and professional e-Learning communities, fx “While structure is an important part of any classroom or training environment, this research shows that it is absolutely critical in an online environment.” (Hauser, Paul, & Bradley, 2008). That said, the importance of some of the interrelated factors ‘instructional scaffolding’, ‘modeling’, ‘support’, and ‘interaction’ still receive little attention in design. Though e-Learning is often stated as equally or more effective than face-to-face learning, these factors are generally considered critical to the effectiveness of e-Learning as illustrated with the following papers: “Students valued interaction with instructor as an important factor in online learning. New students had a better success rate in instructor-led online courses than in independent-study online courses. Adult students need modeling and scaffolding to be successful in an online environment.” (Jiang, Parent, & Eastmond, 2006); “...the supported training group had a significantly higher program completion rate than the independent group.” (Bennett-Levy, Hawkins, Perry, Cromarty, & Mills, 2012); “Results indicate teachers attributed improved student learning to technology use; online communication with peers and experts reduced teacher isolation, enhanced professional practice, and gave access to perspectives and experiences otherwise unavailable; but the additional workload discouraged several teachers.” (Hawkes & Good 2000). The last article also emphasizes the need to consider both time available to the learners as well as the expected workload of the e-Learning (see also Noesgaard, 2014).

4.1 Why is this important?

Understanding factors which research deems critical for e-Learning effectiveness in adult contexts can enable learning professionals to reflect on their priorities in learning design. The list can be used as a form of check-list to ensure that those factors which learning professionals consider relevant for their specific e-Learning participants, contexts, and solutions are taking into account.

5. Conclusions

This paper has discussed the following research questions: How is the effectiveness of e-Learning defined? How is the effectiveness of e-Learning measured? What makes e-Learning solutions effective? It has shown the multiple ways to define effectiveness. Further, the authors highlighted the benefits of reflection on and clarification of the way in which these definitions are brought into play in research and practice. The definitions qualify certain measurements of effectiveness. In this regard, this paper suggests that applying

purely quantitative measures on the fulfilment of pre-defined learning objectives disallows research and practice to capture unexpected and unintended transfer to practice and presents potential sources of error. However, including open-ended qualitative questions in surveys can substantially improve the validity of such approaches. Lastly, this paper has presented factors promoting and prohibiting the effectiveness of e-Learning, and it encourages learning professionals to consider these factors, especially the contextual ones, when designing for e-Learning effectiveness.

6. Limitations and further work

The literature study has certain limitations: First of all, the fact that the analysis is based on abstract and only to a small extent takes the full papers into account, categorizes the papers in ways which may have been slightly different had the full papers been analyzed. Second of all, e-Learning is dealt with as one single concept, while it entails a great variety of delivery methods, technologies, and learning designs. These variations are, however, also coded in the literature study, and the authors look forward to unfolding the concept of e-learning generally as well. Third of all, the literature study considers a large number of papers compared to other literature studies. Still, the quantitative analyses will benefit from the number of coded abstracts increasing as the study proceeds, since some of the findings are based on relative small numbers for this approach (Table 2). The qualitative findings also become richer and more nuanced as the number of papers grows. Last of all, the reader must know that both researchers have been involved in discussions of the design of the e-Learning solution tested in the empirical study. Hence, the researchers may also be affected by 'effectiveness bias'. The researchers will continue to debate these concerns as the study continues.

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